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Comprehensive Review Discussion of Science Technology Engineering and Mathematics (STEM) Learners in Operations of Integers: An Action Research

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ABSTRACT
Based on perceived general observation, most Senior High School students tend to have difficulties in performing the four basic operations to the set of numbers called "integers". An integer is a whole number that can be positive, negative, or zero. This study chose Grade 11 Science Technology Engineering and Mathematics (STEM) students as the targeted respondents for this particular action research. It aims to aid STEM students in their struggles on performing operations of integers. The study will use Review Discussion as the intervention and aid for the problem. Results and Interpretation are obtained by using various appropriate statistical formulas like t-test and standard deviation. The researchers conducted this action research to verify if review discussion will have a positive effect and impact on enhancing the skills of Grade 11 STEM students in operations of integers.

KEYWORDS
Action research; integers; STEM students; basic operations

INTRODUCTION

One good indicator of student success on their academic performance at the high school and post - secondary level is their mastery in algebra. (Bryant, 2020).To enhance the students'mastery and foundation of algebra, It is a necessity to be able to give them significant preparation and readiness in studying integers. According to the data analysis from differentkinds of literature, students have difficulty interpreting negative numbers and conducting operations that includes negative numbers. (Alfarisi, et.al. 2022). The poor performance of students in all four basic operations to integers is one of the major concerns in teaching mathematics in the Philippines. Many elementary school learners with instrumental understanding have made several mistakes in solving negative integer. (Amir, et.al., 2022). There are a ton of reasons and factors why students find it difficult. A study made by Khalid and Embong (2019) found that the sources of errors were found to came from carelessness and lack of basic knowledge such as the inability to multiply and divide even integers, and the inability to dissect concepts of integers since they are used to the schemes of whole numbers and rule mix-up which is also the result of surface understanding.

Another study made by the same authors stated that students' understanding of integers was improved due to the presentation of concepts through manipulatives, images, and verbal/symbolic representation which were also employed during the implementation.

(Khalid and Embong, 2020). There are various studies which analyzed a ton of different models in terms of teaching integer concepts, which admits that it failed to completely help with the understanding of the concept of operation representation in integers (Cetin, 2019). Even if the teachers stated that students have no problems in learning positive integers, it is observed that students have circumstances in understanding and comparing negative integers, and as well as presenting them on the number line. Students also have difficulty in performing operations with negative integers. It is discovered that they have problems in the addition of numbers with different signs and the multiplication and division of negative integers. (Demir, et.al., 2017). Furthermore, a result from study made by Febriyanti, et.al, (2018), suggest that teachers should exercise the students to explore more about their imagination and reasoning in solving a particular problem. Another factor toconsider is the capacity of students' skills in terms of problem-solving. Problem-solving behavior is an important component for any student because problem solving behavior can give provided characteristics of the student's behavior during the process of solving different mathematics word problems. (Aziz, et.al., 2018). Learning mathematics is not limited to only production of students who succeed in mathematical and procedural calculations but also improves and enhance religious thinking (Muslimin et.al., 2020). Reasoning is a part of the thinking method of students to draw conclusions from a problem. Reasoning behavior students have lured many researchers to evaluate the development of students' critical thinking in mathematics. Especially in problem solving that ends in a conclusion. The skill of reasoning acts an important role in students to learn the concept and nature of mathematics (Padang, et.al., 2018). Findings from a study written by Sovia and Herman indicates that slow learners tend to face struggless in understanding and comprehending mathematical problems, developing problem-solving strategies, using appropriate operations, and forming conclusions. (Sovia and Herman, 2019). The general flowchart of the learning study shows an inclusive practice, while pre-test and post-test achievement together with data from the lesson found out a mixed picture concerning student achievement. It implies that differences in student achievement are related to the point which students participate in inclusive teaching and learning practices (Lovstrom, et.al., 2020). In this action research study, Senior high school STEM students will take part in a pre-test/post-test and review discussion intervention short program. STEM learning makes students a problem solving, inventor, innovator, independent, logical thinkers, technology literacy, able to connect their culture and history with education, and the world work (Khairani et al. 2023). The main purpose of this action is to enhance the abilities and skills of Senior High School STEM students in terms of solving and operating operations of integers.

LITERATURE REVIEW

Conceptual Framework

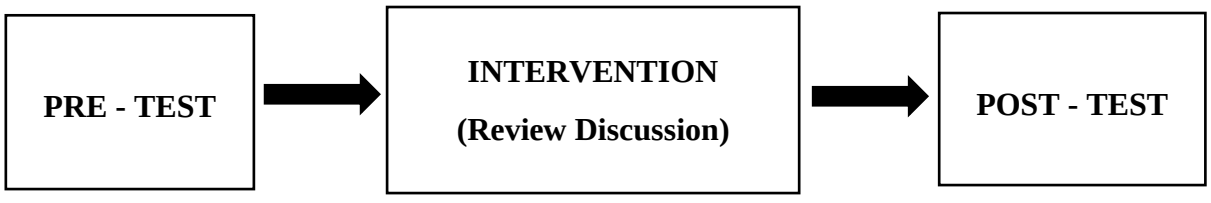

Figure 1. Research Paradigm

The conceptual framework above presents the data to be used by the researchers in implementing the action research. A 10-item questionnaire will be used to evaluate the skills of Grade 11 STEM students in terms of performing and solving operations of

integers. A pre-test will be given first to the students to test their current skills about the topic. A comprehensive review discussion will follow to remind and recall students about the rules and processes in terms of solving operations of integers. Then, a post-test will be conducted to the same set of students to determine if the review discussion intervention has a positive, negative, or no effect on the scores of Grade 11 STEM students.

Conceptual Framework

Malik and Alam (2019) design theorized that Pre-test/post-test model are important evaluation instruments that help in the direct and useful evaluation of a subject or lecture to enhance student learning. The main point of pre-test/post-test evaluation model is to measure the basic knowledge of learners at the beginning of a lecture and compare it with the knowledge absorbed after the intervention. Observing the relationship between participants' post-test scores to their pre-test scores enables us to see whether the intervention was successful in enhancing learners' knowledge of the taught subject matter.

Statement of the Problem

This action research was aimed to know if a Review Discussion intervention will help rade 11 STEM students enhance their skills in solving the operation of integers. The goal of the implementation of the action research is to answer the following questions:

1. What are the performance scores of Grade 11 STEM students in the operation of integers according to their:
   1.1 Pre-test scores
   1.2 Post-test scores
2. Is there a significant difference between the scores of Grade 11 STEM students in their pre-test and post-test?
3. What are the effects of the Review Discussion intervention on the ability of Grade 11 students in terms of solving the operation of integers?

Hypotheses

H_0: There is no significant difference between the performance of Grade 11 STEM students in their pre-test and post-test about solving operations of integers.

H_1: There is a significant difference between the performance of Grade 11 STEM students in their pre-test and post-test about solving operations of integers.

RESEARCH METHODS

The method of research used in this study is the "descriptive method of research". Descriptive research is a type of research in which the primary goal is to correctly and accurately describe a population. (Mccombes. 2019), The descriptive method is defined as a purposive process of gathering, analyzing, classifying, and tabulating data. It usually uses survey questionnaires to gather data. The researcher applied the Descriptive Method of research with the questionnaire as the main data-gathering instrument since this study focused on enhancing the skills of Grade 11 Science Technology Engineering and Mathematics students in operating on integers. This method describes and interprets "what is". It is directed towards conditions or relationships that exist, practices thatprevail, beliefs, points of view, processes that are going on effects that are being felt, or trends that are developing. The system of descriptive goes beyond mere gathering and tabulating data. It involves an element of interpretation of the meaning or significance of what is described. The survey gathers data from a relatively large number of cases in a particular time. It is

concerned with the generalized statistics that result when data are abstracted from the number of individuals. Descriptive research is defined as research method that describes the description of the population or phenomenon studied. This methods focuses on the "what" concept of the research subject than the "why" concept of the research subject (Bernal et.al., 2020).

This study selected 50 Science Technology Engineering and Mathematics (STEM) students to be the respondents in testing their ability in terms of operating integers. The researchers utilized a questionnaire containing of different kinds of solving operation of Integers. The process of the utilization of this instrument is breadown into two; Pre-Test and Post-Test. Pre-test is done before the review discussion intervention to measure their prior knowledge. Post-test on the other hand is given after the review is done. This helps the researchers to identify and judge whether the used and applied intervention is effective or not.

The comprehensive review discussion will cover all necessary rules and techniques that Grade 11 STEM students need to remember and relearn when they take their senior high school math subjects like General Mathematics, Pre–Calculus, Probability and Statistics, and Basic Calculus. Due to this review discussion, students will remember their past lessons about solving and performing operations of integers. Additionally, they will be able to recall the different rules in each basic operation used to the set of numbers called integers. Consequently, it is expected for students to at least improve their scores in post–test compared to their pre -test after the said review discussion intervention. This action research aims to help students in their mastery of integers in their mathematics classes.

Ethical Consideration

In the process of executing this action research, there are ethical considerations that were noted. The respondents of this study will be composed of Grade 11 STEM students who gave their agreement in participation in this study. For respondents who are underaged (below 18 years old), parental consent is collected to ensure the safety of the respondents' information and data. Furthermore, the results or scores obtained by the students for pre – test and post – test will not have any particular effect on the grades of the learners chosen as respondents.

Research Instruments

Research Instrument are the tools used to gather required data. Data is a must in a study due to the fact that it provides the basis for observations. In order to gain the data needed, the researchers used a questionnaire as the main research instrument. This paper will use a 10-item questionnaire about the operation of integers. The questionnaire will cover all basic operations namely; addition, subtraction, multiplication, and division of integers. The instrument is made by the collaborative brainstorming of mathematics teachers. To assure the validity and reliability of the said instrument, 2 mathematics experts were asked to validate the questionnaire. This is to strengthen the appropriateness of the 10-item questionnaire in terms of the skill level of Grade 11 STEM students.

Statistical Tools/Treatment of Data

This part shows the different formulations and equations used in computing and interpreting different data collected. Additionally, it also presents the correlation of the different variables included in the research study.

• Percentage Distribution

This formula is used to show the percentage of the total frequency that is equated to 100. This was necessary to get the percentage of the frequency of responses for a specific problem.

Formula:

$$\% = \frac{f}{n} x\ 100$$

Where:

f – Frequency of respondents

n – Number of the total respondents

• Mean

The mean was used to measure the central tendency of the academic performance of the Grade 11 STEM students. The mean is computed by getting the sum of all scores, and dividing it by the number of respondents in the population.

$$\bar{x} = \frac{\sum x_i}{n}$$

Where:

$\sum x_i$= the sum of all the scores, n = number of scores

• Standard deviation

This formula expresses how tightly all the various examples are clustered around the mean in a given set of data.

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{(n)}}$$

Where:

x = ungrouped data

$\bar{x}$ = mean of the data

s = Standard Deviation

n = number of measurements

• T-Test

This formula is used to calculate the significant difference between groups. It is used by the researchers to calculate the difference between these factors comparing with only two variables.

$$t = \frac{|\bar{x}_1 - \bar{x}_2|}{\sqrt{\frac{(s_1)^2}{n_1} + \frac{(s_2)^2}{n_2}}}$$

T-test will be the main statistical treatment to be done in this action research study. This tool will determine if there is a significant difference between the student's pre-test and post-test performance. Additionally, this will also evaluate if the given review discussion intervention has any effect on the enhancement and development of the skills of Grade 11 stem students in terms of solving and performing operations of integers.

RESULTS AND DISCUSSION

Grade 11 STEM Students' Performance in Solving Operations of Integers

The researchers used a 10-item questionnaire about the operation of integers to test and evaluate the skills of Grade 11 STEM students in performing and solving operations of integers.

Table 1. Impact of Review Discussion Intervention on the Scores of Grade11 Students in Solving Operations of Integers According to Their Mean Scores

Test	Mean	No. of Students	Standard Deviation
Pre – Test	7.02	50	2.57
Post – Test	8.22	50	1.70

This study computed the mean and standard deviation of the scores achieved by the Grade 11 stem student respondents. There are 50 students who took the pre – test and post – test about operations of integers. In the pre-test, the students have a mean score of 7.02 over 10 points. Comparitively, the students perform better in post-test with a mean score of 8.22 out of 10 points. The standard deviation in post-test is also significantly lower which implies that the spreadness of scores are more scattered during the pre-test. Consequently, it can be assumed that in the post test, there are more students whose scores are nearly equal to the mean which is 8.22. Therefore, it can safely conclude that the review discussion intervention has a positive effect on the enhancement and development of skills of Grade 11 STEM students in terms of solving and performing the operation of integers.

The results show that the comprehension review intervention is an effective way to help students improved their ability to perform different operations of integers. This mirrors the results of a related action research paper made by Prasanna (2019) entitled "Action research On Addition of Positive and Negative Numbers"; where there is also a significant increase from students' pre - test performance compared to their post – test performance after applying a comprehensive review discussion about addition of positive and negative numbers.

Table 2. The Difference Between the Scores of Grade11 Stem Students in Their Pre-Test and Post-Test About Operations of Integers

Test	No. Of Students	Mean	Stadard Deviation	T	df	p
Pre – Test	50	7.02	2.57	-2.73	49	.0075
Post – Test	50	8.22	1.70			

Aside from mean and standard deviation, this action research also uses t test and p value to determine the significant difference between the performance of Grade 11 STEM students in their pre – test and post – test. Based on the results, the t computed value is -2.73 which can be interpreted as there is a significant difference between the performance of the respondents during their pre – test and post – test examinations. Additionally, the p value computed .0075 is less than .01 or 1%. This implies that the review discussion intervention has a very significant effect on the development and enhancement of the skills of Grade 11 STEM students in terms of performing and solving operations of inetegers. A related paper entitled "Enhancing The Skills In Mathematical Operations On Integers of Grade 7-Flexibility Using Integer Operation Work Mat" written by Socrates (2023); reflected a similar result where it states that there is a significant difference between the performance of Grade 7 respondents in their pre-test and post-test examination after the Integer Operation Work Mat intervention was used in the study.

CONCLUSION

After the analysis and interpretation of the findings, the researchers came up with the following conclusions:

1. The scores of Grade 11 students in the pre-test are more scattered than their scores in the post-test.
2. The scores of Grade 11 students in the pre-test are significantly lower than their scores in the post-test.
3. The Review Discussion intervention has a positive effect on developing and enhancing the skills of Grade 11 students in performing and solving operations of research.

Recommendation

After the analysis and interpretation of the findings, the researchers came up with the following recommendations:

1. Give Students pre-test examinations about pre-requisite math topics.
2. Use Comprehensive Review Discussion as an intervention in enhancing the forgotten mathematics skills of students.
3. Conduct a post-test examination on the chosen math topics that needs to be relearned.
4. In reviewing the operation of integers, make sure to list all the rules and steps that are needed to guide the learners in solving and performing the operations of integers.

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